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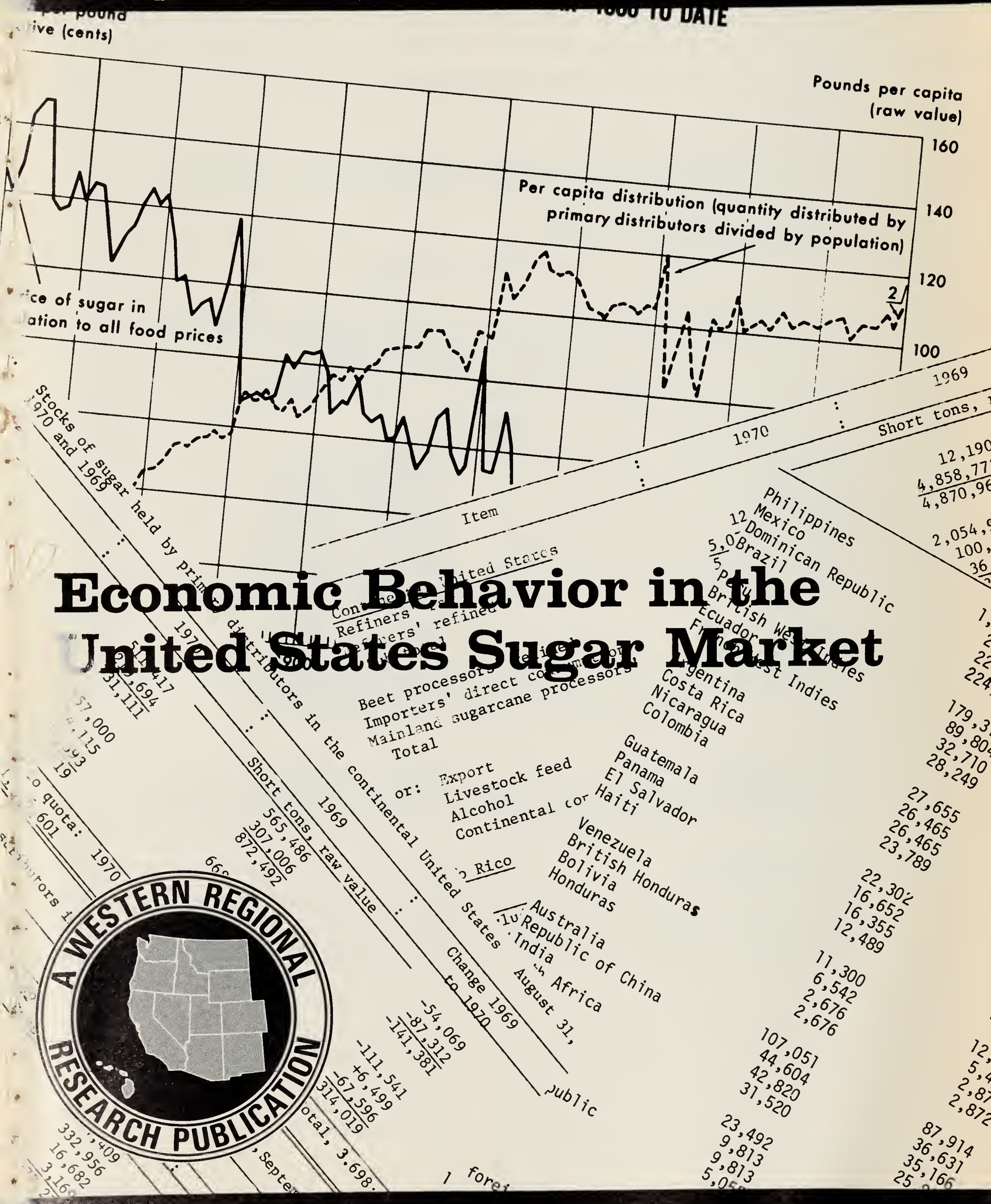

# Economic Behavior in the United States Sugar Market

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This report summarizes the most important findings of the regional research project WM-51, Economic Factors Affecting Sugar Marketing, at agricultural experiment stations in North Dakota, Louisiana, Colorado, Utah, Montana, Michigan, Minnesota, Idaho, California, Hawaii, and Puerto Rico. It also includes related studies by the Economic Research Service of the U. S. Department of Agriculture. Many of these findings have been published by these experiment stations and by the Economic Research Service; others are in unpublished form. They are listed on pages 28 and 29 of this bulletin.

Thus, this report is the result of coordinated endeavor, and many of the participants are authors of the publications from which this report is derived.

An abstract appears on page 29

**October, 1972**

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# Economic Behavior in the United States Sugar Market[1]

## INTRODUCTION

THE UNITED STATES EMBARGO on Cuban sugar imports in 1960 was followed by abrupt changes in the sources of this country's sugar imports and a corresponding rearrangement of international trade in sugar among other nations. Unusually high sugar prices in 1963 and 1964 also stimulated producer and consumer interest in questions related to the marketing of sugar and other sweeteners in the United States.

Since 1964, a number of new questions affecting the sugar industry in the United States has arisen: increasing competition from substitute sweeteners; the integration of a considerable number of sugar-producing companies with corporations engaged in various activities not related to sugar; revisions in the United States sugar quota law; shifts in the relative importance of various domestic and foreign sources of supply; and concern over the capacity of certain foreign suppliers to fill their United States quota.

The purpose of this report is to summarize the findings of a number of a number of individual studies of the economics of sugar marketing, and to relate them to recent developments in the domestic sweetener industry and international trade in sugar.[2] The policy roles of the United States and various foreign governments toward their domestic sugar industries and international trade in sugar also will be considered.

## RECENT TRENDS IN SWEETENER CONSUMPTION AND COMPETITIVE RELATIONSHIPS

The three major sweeteners in commercial use in the United States are: beet and cane sugar, corn or starch sweeteners (corn sirup and dextrose), and noncaloric sweeteners (table 1). The principal noncaloric sweetener now in use is saccharin, although another sweet and nonnutritive substance, cyclamate, was used extensively until its restriction in late 1969 and, later, its ban by the U. S. Food and Drug Administration for food use. Sweeteners of minor importance (principally honey, maple and cane sirups, and molasses) are also used in the United States, but are not considered in this study.

Sugar is the most important sweetener used in the United States. However, while the volume of sugar sales has increased, sugar's share of the total sweetener market has declined moderately in recent years. From 1957 to 1967 the consumption of sugar increased 19 per cent, as compared with 62 per cent for corn sweeteners and 233 per cent for noncaloric sweeteners. The recent ban on the use of cyclamates, no doubt, has reduced substantially the use of noncaloric sweeteners, although supporting data are not yet available.

Something like one-fourth of the sugar consumed in the United States is deliv-

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[1] Submitted for publication December 28, 1971.

[2] See Reports of Work Done Under and Related to WM-51, "Economic Factors Affecting Sugar Marketing," on page 28 for literature cited.

TABLE 1.

ESTIMATED CONSUMPTION OF SWEETENERS IN THE UNITED STATES (1957 TO 1969)

| Year | Sugar* | Corn sweeteners* | Noncaloric sweeteners† | Total |
|---|---|---|---|---|
| | *1000 tons* | | | |
| 1957 | 7,950 | 1,044 | 225 | 9,219 |
| 1958 | 8,210 | 1,165 | 230 | 9,575 |
| 1959 | 8,336 | 1,208 | 235 | 9,779 |
| 1960 | 8,423 | 1,238 | 240 | 9,901 |
| 1961 | 8,775 | 1,273 | 250 | 10,298 |
| 1962 | 8,881 | 1,397 | 275 | 10,553 |
| 1963 | 9,136 | 1,520 | 453 | 11,109 |
| 1964 | 8,839 | 1,636 | 646 | 11,121 |
| 1965 | 9,183 | 1,654 | 659 | 11,496 |
| 1966 | 9,523 | 1,719 | 712 | 11,954 |
| 1967 | 9,488 | 1,695‡ | 750 | 11,933 |
| 1968 | 10,106 | § | § | ... |
| 1969 | 9,884 | § | § | ... |

* Dry-weighted, refined.
† Equivalent sweeteners: saccharin is 300 times and cyclamate is 30 times as sweet as sugar.
‡ Estimated.
§ Data not available.

ered in packages for consumers and sold at retail. Only small amounts of dextrose and corn sirup are marketed through retail channels. Most corn sweeteners are used by industrial food processors, often in blends of sugar and corn sirup. About two-thirds of the sugar consumed in the United States is used in industrial food processing. However, sugar's proportion of the sweeteners used by food processors has declined since 1957.

The most important nonsugar sweeteners in use in the United States are corn sirup and dextrose. These products are manufactured in the United States by the corn wet-milling industry from corn starch, although they can be produced from starch obtained from other plants. Nearly all these sweeteners are sold to industrial users, mainly food processors. The corn sweeteners are carbohydrate foods, as in sugar, but (with the exception of a recently developed high levulose sirup) they are considerably less sweet than sugar. Also corn sirup, the most important corn sweetener, does not crystallize. Some of the corn sweeteners used in the United States have served as replacements for sugar. In other uses where these substances appear to improve the quality and salability of the product manufactured, they may have served primarily to increase the total quantity of caloric sweeteners used in this country rather than to reduce the demand for sugar.

The use of corn sirup in the manufacture of hard candy provides an excellent example of increasing total sweetener use. It is difficult to manufacture hard candy of good quality without the use of corn sirup as a substantial part of the raw material. Without corn sirup, the consumption of hard candy might be considerably smaller than the present output. In other cases, such as the use of dextrose in baking, the major effect is the substitution of dextrose for sugar. Dextrose commonly is cheaper than sugar and is used in bakery products made with yeast.

In recent years certain corn sirup producers have started marketing sirups in which a part of the dextrose has been converted to levulose. Since levulose is sweeter than sucrose (sugar) and much sweeter than dextrose, these sirups, commonly called high-levulose or high-fructose, are sweeter than other types of corn sirup and approach the sweetness of sugar. High-levulose sirups have not been marketed long enough or in sufficient quantity to make possible an accurate appraisal of their likely importance in various uses or their effect on the market for sugar.

Prices of corn sweeteners, particularly corn sirup, have declined considerably compared to the price of sugar in the United States since the mid-1950's. The wholesale price of corn sirup (dry basis) relative to that of sugar averaged 100 per cent in 1957 and only 70 per cent in 1970. During the same time span, the wholesale price of dextrose (dry basis) relative to that for sugar declined from 91 to 85 per cent.

This decline in corn sirup prices has been accompanied by an increase in the use of corn sirup over that of sugar in certain industrial uses. For instance, in the canning industry during the period 1957 to 1966 (exclusive of 1964 when high sugar prices distorted the price ratio) a 10 per cent decline in the price of corn sirup compared to the price of sugar was accompanied by an increase of 3.5 percentage points in the proportion of corn sirup in the sweetener used in the industry. In the dairy industry the increase was 5.4 points and in the baking industry 3.9.[3]

In other food industry uses, primarily beverages and confectionery, there was little apparent relationship between changes in the corn sirup-sugar price ratio and the percentage of corn sirup in the sweeteners. The use of corn sirup in the beverage industry has always been comparatively small. The advantage of lower prices has not been sufficient to change the situation materially. The confectionery industry is the largest user of corn sirup, but the type of candy containing the largest proportion of corn sirup seems to have declined in relative importance, so that the use of corn sirup in the industry has increased at a slower rate than that for sugar.

In 1966, the latest date for which data are available, the canning, dairy, and baking industries used slightly more than 3 million tons of sugar plus corn sirup, and corn sirup prices relative to sugar prices were 19 per cent below 1957. These figures suggest that in 1966 purchases of sugar for use in these industries were about 175,000 tons less than would have been expected if the sugar-corn sirup price relationship had remained at the figure for 1957.

This estimate assumes that the total demand for sugar plus corn sirup in these industries was inelastic to price changes at the price levels prevailing from 1957 to 1966. The price elasticity of sugar in the United States is generally recognized as being very low. The Food and Agricultural Organization in discussing the elasticity of demand for sugar in the United States says, "The data demonstrate that in this country income and price are no longer decisive or even significant factors determining sugar consumption."[4]

Similar studies of the elasticity of demand for corn sirup are not available. However, corn sirup accounts for less than one-fifth of the total quantity of sugar plus corn sirup used in the canning, dairy, and bakery industries, and the combined elasticity for sugar plus corn sirup is not likely to differ much from that for sugar alone.

Since the ban, for health reasons, on the use of cyclamate by the U. S. Food and Drug Administration, the only noncaloric sweetener of much commercial importance in the United States is saccharin. The extent to which saccharin is used as a substitute for sugar is unknown, but it is apparent that a large share of it is used by persons who, for health reasons (including a desire to control their weight), would consume little, if any, sugar. It seems likely that the substitution of noncaloric sweeteners for sugar decreased somewhat when cyclamates were removed from the market. Cyclamates had been mixed with saccharin to reduce the bitter taste of the latter, which is objectionable to some people.

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[3] Roy A. Ballinger, A history of sugar marketing. AER No. 197 (USDA, Washington, D.C., Feb. 1971).

[4] From "Trends and forces of world sugar consumption," by A. Viton and F. Pignalosa. Commodity Bulletin Series 32 (FAO, Rome, 1961), 41 pp.

## UNITED STATES SUGAR SUPPLY AND INTERNATIONAL TRADE

Since the end of World War II, United States sugar consumption has increased at an average rate of about 161,000 tons, raw value, per year, rising from around 7 million tons in 1948 to nearly 11 million tons in 1969 (table 2). This increase has been at about the same percentage rate as the growth of population in the United States; thus per capita consumption has remained approximately constant at slightly more than 100 pounds (except for some increase in 1968 and 1969).

United States sugar shipments coming from both domestic areas and foreign countries have increased since 1948. The domestic increase has averaged about 111,000 tons per year—for imports 50,000 tons. There have also been sizeable shifts in the relative importance of various domestic areas and countries from which sugar has been imported (tables 3 and 4). Beet sugar has accounted for the largest share of the increase in domestic production, although the mainland cane area has shown the greatest rate of increase. Increased supplies from Hawaii have been comparatively small, and Puerto Rican receipts have decreased. About 70 per cent of the increase in sugar imports has come from the Philippines. Supplies from Cuba and other countries accounted for the remainder. Until 1960 Cuba was our largest foreign supplier. Since the end of imports from Cuba, the United States has

TABLE 2.

SUGAR AVAILABLE FOR CONSUMPTION (CHARGES AGAINST QUOTAS) IN CONTINENTAL UNITED STATES (1948 TO 1969)

| Year | Domestic areas | Imports | Total | Share from domestic areas |
|---|---|---|---|---|
| | *1,000 short tons, raw value* | | | *Per cent* |
| 1948 | 3,843 | 3,241 | 7,084 | 54.2 |
| 1949 | 3,908 | 3,680 | 7,588 | 51.5 |
| 1950 | 4,480 | 3,799 | 8,279 | 54.1 |
| 1951 | 4,093 | 3,665 | 7,758 | 52.8 |
| 1952 | 4,100 | 3,891 | 7,991 | 51.3 |
| 1953 | 4,479 | 3,803 | 8,282 | 54.1 |
| 1954 | 4,435 | 3,805 | 8,240 | 53.8 |
| 1955 | 4,439 | 3,957 | 8,396 | 52.9 |
| 1956 | 4,795 | 4,197 | 8,992 | 53.3 |
| 1957 | 4,666 | 4,250 | 8,916 | 52.3 |
| 1958 | 4,379 | 4,697 | 9,076 | 48.2 |
| 1959 | 4,766 | 4,474 | 9,240 | 51.6 |
| 1960 | 4,532 | 4,990 | 9,522 | 47.6 |
| 1961 | 5,432 | 4,300 | 9,732 | 55.8 |
| 1962 | 5,201 | 4,596 | 9,797 | 53.1 |
| 1963 | 5,960 | 4,555 | 16,515 | 56.7 |
| 1964 | 5,523 | 3,586 | 9,109 | 60.6 |
| 1965 | 6,095 | 3,825 | 9,920 | 61.4 |
| 1966 | 6,040 | 4,135 | 10,355 | 58.3 |
| 1967 | 5,951 | 4,433 | 10,384 | 57.3 |
| 1968 | 5,985 | 4,966 | 10,951 | 54.7 |
| 1969 | 5,887 | 4,850 | 10,737 | 54.8 |

### TABLE 3.
### UNITED STATES SUGAR SUPPLIES FROM DOMESTIC AREAS (1948 TO 1969)

| Year | Continental U. S. | | Hawaii | Puerto Rico | Virgin Islands | Total |
|---|---|---|---|---|---|---|
| | Beet | Cane | | | | |
| | *1,000 short tons, raw value* | | | | | |
| 1948 | 1,656 | 456 | 714 | 1,013 | 4 | 3,843 |
| 1949 | 1,487 | 557 | 769 | 1,091 | 4 | 3,908 |
| 1950 | 1,749 | 522 | 1,145 | 1,053 | 11 | 4,480 |
| 1951 | 1,730 | 457 | 941 | 959 | 6 | 4,093 |
| 1952 | 1,560 | 579 | 972 | 983 | 6 | 4,100 |
| 1953 | 1,749 | 513 | 1,087 | 1,118 | 12 | 4,479 |
| 1954 | 1,802 | 501 | 1,040 | 1,082 | 10 | 4,435 |
| 1955 | 1,797 | 500 | 1,052 | 1,080 | 10 | 4,439 |
| 1956 | 1,955 | 601 | 1,091 | 1,135 | 13 | 4,795 |
| 1957 | 2,066 | 636 | 1,037 | 912 | 15 | 4,666 |
| 1958 | 2,240 | 680 | 630 | 823 | 6 | 4,379 |
| 1959 | 2,241 | 578 | 977 | 958 | 12 | 4,766 |
| 1960 | 2,165 | 619 | 845 | 896 | 7 | 4,532 |
| 1961 | 2,607 | 784 | 1,045 | 980 | 16 | 5,432 |
| 1962 | 2,415 | 787 | 1,084 | 904 | 11 | 5,201 |
| 1963 | 2,965 | 1,072 | 1,033 | 875 | 15 | 5,960 |
| 1964 | 2,699 | 905 | 1,110 | 793 | 16 | 5,523 |
| 1965 | 3,025 | 1,099 | 1,137 | 830 | 4 | 6,095 |
| 1966 | 3,024 | 1,100 | 1,200 | 711 | 5 | 6,040 |
| 1967 | 2,824 | 1,169 | 1,253 | 705 | 0 | 5,951 |
| 1968 | 3,085 | 1,204 | 1,192 | 504 | 0 | 5,985 |
| 1969 | 3,216 | 1,170 | 1,160 | 341 | 0 | 5,887 |

imported sugar from about 30 countries, with the largest quantities exclusive of the Philippines, coming from the Dominican Republic, Mexico, Brazil, and Peru. However, total imports from these four countries have amounted to only about two-thirds the average receipts from Cuba before 1960.

### TABLE 4.
### UNITED STATES SUGAR SUPPLIES FROM FOREIGN COUNTRIES (1948 TO 1969)

| Year | Philippines | Cuba | Other foreign countries | Total |
|---|---|---|---|---|
| | *1,000 short tons, raw value* | | | |
| 1948 | 252 | 2,927 | 62 | 3,241 |
| 1949 | 525 | 3,103 | 52 | 3,680 |
| 1950 | 474 | 3,264 | 61 | 3,799 |
| 1951 | 706 | 2,946 | 13 | 3,665 |
| 1952 | 860 | 2,980 | 51 | 3,891 |
| 1953 | 932 | 2,760 | 111 | 3,803 |
| 1954 | 974 | 2,718 | 113 | 3,805 |
| 1955 | 977 | 2,862 | 118 | 3,957 |
| 1956 | 982 | 3,089 | 126 | 4,197 |
| 1957 | 906 | 3,127 | 217 | 4,250 |
| 1958 | 980 | 3,438 | 279 | 4,697 |
| 1959 | 980 | 3,215 | 279 | 4,474 |
| 1960 | 1,155 | 2,390 | 1,445 | 4,990 |
| 1961 | 1,355 | 0 | 2,945 | 4,300 |
| 1962 | 1,256 | 0 | 3,340 | 4,596 |
| 1963 | 1,195 | 0 | 3,360 | 4,555 |
| 1964 | 1,217 | 0 | 2,369 | 3,586 |
| 1965 | 1,178 | 0 | 2,647 | 3,825 |
| 1966 | 1,186 | 0 | 3,129 | 4,315 |
| 1967 | 1,123 | 0 | 3,310 | 4,433 |
| 1968 | 1,124 | 0 | 3,842 | 4,966 |
| 1969 | 1,125 | 0 | 3,725 | 4,850 |

### Table 5.

### TRENDS IN UNITED STATES AND WORLD SUGAR PRODUCTION AND TRADE (1948 TO 1969)

| Year | Production | | | Imports | | |
|---|---|---|---|---|---|---|
| | World | United States | | World | United States | |
| | *1,000 tons* | *1,000 tons* | *Per cent* | *1,000 tons* | *1,000 tons* | *Per cent* |
| 1948 | 31,375 | 3,843 | 12.2 | 10,827 | 3,225 | 29.8 |
| 1949 | 31,944 | 3,908 | 12.2 | 11,031 | 3,753 | 34.0 |
| 1950 | 35,989 | 4,480 | 12.4 | 12,387 | 3,707 | 29.9 |
| 1951 | 38,604 | 4,093 | 10.6 | 11,898 | 3,666 | 30.8 |
| 1952 | 37,499 | 4,100 | 10.9 | 12,543 | 3,872 | 30.9 |
| 1953 | 41,525 | 4,479 | 10.8 | 14,468 | 3,828 | 26.5 |
| 1954 | 41,540 | 4,435 | 10.7 | 13,763 | 3,795 | 27.6 |
| 1955 | 43,464 | 4,439 | 10.2 | 15,206 | 4,011 | 26.4 |
| 1956 | 45,631 | 4,795 | 10.5 | 15,219 | 4,173 | 27.4 |
| 1957 | 49,164 | 4,666 | 9.5 | 16,553 | 4,166 | 25.2 |
| 1958 | 54,542 | 4,379 | 8.0 | 16,960 | 4,765 | 28.1 |
| 1959 | 53,923 | 4,766 | 8.8 | 16,175 | 4,571 | 28.3 |
| 1960 | 60,050 | 4,532 | 7.5 | 18,302 | 4,717 | 25.8 |
| 1961 | 56,989 | 5,393 | 9.5 | 21,279 | 4,226 | 19.9 |
| 1962 | 54,895 | 5,194 | 9.5 | 20,771 | 4,671 | 22.5 |
| 1963 | 59,782 | 5,956 | 10.0 | 19,113 | 4,486 | 23.5 |
| 1964 | 71,992 | 5,528 | 7.7 | 18,777 | 3,596 | 19.2 |
| 1965 | 69,283 | 6,095 | 8.8 | 18,301 | 3,498 | 19.1 |
| 1966 | 70,998 | 6,084 | 8.6 | 19,003 | 3,846 | 20.2 |
| 1967 | 73,029 | 6,028 | 8.3 | 19,940 | 4,252 | 21.3 |
| 1968 | 75,385 | 6,387 | 8.5 | 19,609 | 4,654 | 23.7 |
| 1969 | 79,671 | 6,166 | 7.7 | 18,789 | 4,432 | 23.6 |

In recent years about one-fourth of the sugar produced in the world has entered international trade, the remainder being consumed in the countries where it was produced (table 5). Prior to 1964 about one-third of world production was exported. Nearly all of the sugar entering international trade is raw cane sugar. Most of the world's sugar exports come from countries in the tropics where cane sugar is produced and go to countries in the north temperate zone, where the imports supplement domestically produced supplies of beet sugar.

The United States is the world's largest sugar importer. In 1968, sugar imports were valued at $610,923,000, equal to 13 per cent of the value of all agricultural imports that year. Among imports of agricultural products, only coffee exceeded sugar in value.

Four countries—the United States, United Kingdom, USSR, and Japan—import more than half the sugar entering world trade (table 6). Cuba accounts for about one-fourth of world sugar exports and the Philippines, USSR, Brazil, and Taiwan provide nearly another quarter. The presence of the USSR as both a leading importer and exporter of sugar is the result of its purchases of Cuban sugar at preferential prices. A large part of this sugar is re-exported.

Much of the sugar moving in international trade is sent to importing countries where it is purchased at preferential prices. For instance, all the sugar imported into the United States for quota purposes (about 97 per cent of the total) is sold at prices prevailing in the United States, which are typically higher than world market prices. Preferential prices are also paid for most of the sugar imported by the United Kingdom, the USSR, and France. Canada grants preferential tariff rates to sugar coming from certain countries. The degree of preference varies widely among importing countries and also over time in many of them. While precise figures are not available, the nonpreferential or "free" market is usually estimated at about 10 per

### TABLE 6.
### INTERNATIONAL TRADE IN SUGAR BY PRINCIPAL TRADING COUNTRIES

| Country | Imports | | Country | Exports | |
|---|---|---|---|---|---|
| | 1959–63 | 1968 | | 1959–63 | 1968 |
| | *1,000 tons* | | | *1,000 tons* | |
| United States | 4,534 | 4,989 | Cuba | 5,654 | 5,085 |
| United Kingdom | 2,645 | 2,224 | Philippines | 1,172 | 1,197 |
| USSR | 2,049 | 1,935 | Australia | 1,008 | 1,790 |
| Japan | 1,501 | 2,264 | USSR | 716 | 1,610 |
| Canada | 773 | 951 | Brazil | 695 | 1,189 |
| France | 557 | 377 | Taiwan | 796 | 718 |
| Morocco | 366 | 280 | Dominican Republic | 875 | 672 |
| Other | 6,703 | 8,336 | Peru | 570 | 551 |
| | | | Mexico | 430 | 707 |
| | | | Other | 7,367 | 8,538 |
| TOTAL | 19,128 | 21,356 | TOTAL | 19,283 | 22,057 |

cent of world sugar production, averaging about 6 million short tons from 1959 to 1963 and 8 million tons in 1969.

The preferences offered by importing nations are always made to specific exporting countries and usually for specified maximum quantities each year. In most cases the favored areas have achieved that status largely for political reasons. Frequently these are not the most advantageously located places from which the importing country might obtain sugar.

For instance, about one-fifth of United States sugar imports comes from the Philippines and is unloaded at ports on the Atlantic and Gulf coasts. Some sugar produced in the closer Caribbean and South America is exported to Japan. The result is higher transportation costs for sugar imported into the United States than would otherwise be necessary. There are numerous other examples of transportation inefficiencies.

Statistical estimates of the actual cost of ocean transportation of raw sugar throughout the world indicate that they averaged about \$6.43 per metric ton in 1959.[5] It was also estimated that the lowest cost that could have been achieved by rearranging trade routes to minimize costs would have been \$4.73, a difference of \$1.70 per metric ton. The corresponding figures for 1963 were \$7.25 and \$4.96; the difference is \$2.29 per ton.

The United States embargo on sugar imports from Cuba, imposed in 1960, caused most of the increase in transportation inefficiency from 1959 to 1963. This resulted in increased quantities of Cuban sugar being shipped to more distant destinations and a larger share of United States imports coming from exporting countries more distant than Cuba. In 1959 the actual cost of overseas transportation for United States sugar was 119.7 per cent of the minimum possible cost. In 1963 this increased to 122.3 per cent. In both years, however, the transportation inefficiency for the United States was less than that for other trading blocks such as the United Kingdom and France. Also, the increase from 1959 to 1963 for the United States was smaller than for either the United Kingdom or France.

International trade preferences and import quotas for sugar are part of a protective scheme which has resulted in higher prices for both producers and consumers in the importing countries than would otherwise be expected to prevail.

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[5] T. H. Bates, The world sugar economy and United States supply policy. Ph.D. thesis (University of California, 1966).

Exporters also received higher prices for the limited quantity they are allowed to export to the preferential market. However, the limit placed by the importer on the volume of such exports frequently restricts the size of the sugar industry in the exporting country below what producers there consider desirable or compels them to export sugar to the world market where prices usually are much lower.

# PRINCIPAL STRUCTURAL FEATURES OF THE SUGAR INDUSTRY

The world's commercial sugar is practically all produced from sugarcane and sugar beets. Sugarcane is a member of the grass family which grows only in tropical and semitropical climates. Sugar beets are a temperate zone crop. About 97 per cent of the world's beet sugar is produced in Europe, including the USSR, and the United States. Europe produces only an insignificant quantity of cane sugar, all in Spain, but large quantities of both cane and beet sugar are produced in the United States.

Most of the world's beet sugar is produced in countries which provide substantial protection against imports for their domestic beet industry by means of tariffs, quota systems, and other devices. Consequently, most beet sugar is consumed in the countries where it is produced. The small exports that occur frequently are made to reduce surplus supplies which have accumulated as a result of the protective policies of the exporting country. Other beet sugar producing countries, such as the United States and the United Kingdom, import substantial quantities of sugar while protecting their domestic sugar industries.

In contrast to beet sugar, most of the world's output of cane sugar comes from countries which regularly produce sugar for export as well as for domestic consumption. As a consequence a large proportion of world international trade in sugar is cane sugar. Most of this is raw rather than refined sugar, because many importing countries, including the United States, provide greater protection against the importation of refined than raw sugar.

## Government regulation of the U.S. sugar market

The United States is one of the largest sugar producing and consuming countries in the world. It is also, by a wide margin, the world's largest sugar importer. Production and imports in the United States are regulated by a quota system. There is also a small import duty on sugar.

Under the quota system the Secretary of Agriculture is required to determine the maximum amount of sugar that can be marketed in the United States in any calendar year and to divide this supply among the various domestic producing areas and specified foreign countries according to the provisions of the Sugar Act. The law, prior to 1972, establishes annual quotas for domestic areas of 6,390,000 short tons, raw value, plus 65 per cent of the amount by which the consumption requirements determined by the Secretary of Agriculture for the year exceed 10,400,000 tons, raw value. The remainder of the amount needed to fill consumption requirements is divided among about 30 countries. There are also provisions for reallocating any part of an area's quota that producers in that area are unable to fill in any year.

In 1970, with consumption requirements (the sum of the quotas for all areas) of 11,600,000 tons, domestic and foreign areas were assigned the following quotas after proration of deficits in supplies from Puerto Rico, the Virgin Islands, and certain foreign countries:

| Source | Short tons, raw value | Per cent of consumption requirements |
|---|---|---|
| Domestic: | | |
| 17 states (beet) | 1,597,000 | 31.0 |
| Louisiana and Florida | 1,308,000 | 11.3 |
| Hawaii | 1,145,486 | 9.9 |
| Puerto Rico | 360,000 | 3.1 |
| Virgin Islands | 0 | 0 |
| Total domestic | 6,410,486 | 55.3 |
| Foreign countries: | | |
| Philippines | 1,301,020 | 11.2 |
| Dominican Republic | 678,209 | 5.9 |
| Mexico | 652,559 | 5.6 |
| Brazil | 638,210 | 5.5 |
| Peru | 455,991 | 3.9 |
| British West Indies | 216,645 | 1.9 |
| Australia | 206,270 | 1.8 |
| Ecuador | 92,860 | 0.8 |
| China, Republic of | 85,946 | 0.7 |
| Honduras | 82,508 | 0.7 |
| Argentina | 78,509 | 0.7 |
| Costa Rica | 75,133 | 0.6 |
| Nicaragua | 75,133 | 0.6 |
| French West Indies | 68,149 | 0.6 |
| Colombia | 67,537 | 0.6 |
| Guatemala | 63,314 | 0.5 |
| South Africa | 60,735 | 0.5 |
| Other (14 countries) | 290,786 | 2.6 |
| Total | 5,189,514 | 44.7 |
| Domestic and Foreign | 11,600,000 | 100.0 |

The principal deficits in supplies declared in 1970 were 780,000 tons for Puerto Rico and 15,000 tons for the Virgin Islands. These quantities were prorated among foreign countries.

Under this system, sugar imported from foreign countries sells for the same price, after adjustments for differences in transportation costs and import duty, as sugar produced in domestic areas. In practice, sugar prices in the United States in most years since 1948 have been higher than those in the world market. As a result, foreign countries with a United States quota have always filled that quota except when prevented by unexpectedly small crops or other emergencies. Many countries also have a strong desire for a larger quota.

The Sugar Act provides a system of acreage and marketing controls for domestic areas designed to keep production in each area within the limits of its assigned quota. In order to receive subsidy payments under the Sugar Act, growers of sugar beets and sugarcane are required to conform to the acreage limitations assigned to their farms, when such action is deemed necessary by the Secretary of Agriculture.

The relative size of the quota for each domestic area and foreign country has changed from time to time, when Congress has amended the Sugar Act. The changes which have had the most effect on the marketing of refined sugar in continental United States have been those Sugar Act amendments increasing the proportion of beet sugar in the total supply of sugar for consumption in the United States.

The termination of United States imports of Cuban sugar in 1960 and the distribution of most of this sugar among other exporting countries has altered considerably the world's sugar trade pattern. The more important of these changes in import quotas have been those for raw sugar. Quotas for refined sugar have been reduced; but since these were comparatively small, there has been no marked effect on the marketing of refined sugar in most of the United States. The large increase in Florida's raw sugar production since 1960 did not have much effect on the marketing of refined sugar, except for some increase in refining in southern Florida to avoid the necessity of shipping refined sugar back into the area where the raw sugar was produced.

## Location of U.S. sugar production and processing

Within the United States, the sugar industry is divided into several fairly distinct segments. Sugarcane is grown and raw sugar produced in Hawaii, Louisiana, Florida, and Puerto Rico. Many of the corporations owning and operating raw sugar mills also grow all or a part of the sugarcane they process. Many also buy sugarcane from independent growers. Most of the mills processing sugarcane produce raw sugar for sale to cane sugar refineries. A few mills have some type of refinery attached to the cane-processing plant where they refine the raw sugar they produce and which may also be used to refine raw sugar produced at other cane-processing plants. Also, a few cane-processing mills produce semi-refined sugar which is sold for use without further improvement in quality.

Most of the refined cane sugar produced in the United States is manufactured in separate plants which purchase all the raw sugar they process either from domestic areas or foreign countries. Most Hawaiian sugar is processed in a cooperatively owned plant which ordinarily processes only raw sugar from Hawaii. Most cane sugar refineries are located in or near large coastal cities where raw sugar imports and shipments from Hawaii and Puerto Rico arrive. There are refineries at or near Boston, New York, Philadelphia, Baltimore, Savannah, Houston, and San Francisco. The only other refineries are small inland plants in Chicago, St. Louis, and southern Florida.

Sugar beet processors provide the only other large source of refined sugar for the United States. Mills processing sugar beets in the United States produce refined sugar, which is marketed in competition with refined cane sugar. Sugar beet processing mills are all located in the area where the beets processed by the factory are grown in order to reduce transportation costs for bulky beets. Cane sugar refineries, on the other hand, can be located close to large centers of population to which raw sugar, most of which arrives by ocean vessel, can be transported more cheaply than can refined sugar.

Refined sugar received in continental United States from offshore areas (Hawaii, Puerto Rico, and foreign countries) amounts to about 1 per cent of the total supply of refined sugar available to consumers in the United States. Most of this is consumed in or near the ports through which it enters and has little effect on the refined sugar market, except in local areas.

In 1969 about 80 per cent of the United States crop of beet sugar was produced west of 100° longitude which passes through the middle of North Dakota. Another 12 per cent was in the Red River Valley in eastern North Dakota and Minnesota. Only 8 per cent was produced in states east of the Mississippi River. In contrast to the western location of beet sugar production, nearly half of the beet sugar sold in 1969 was distributed in states east of the Mississippi River. This separation of major producing and consuming regions is responsible for the high transportation costs incurred by the beet sugar industry.

In addition to the 11 companies producing beet sugar in the United States in 1969, there were 15 companies engaged in refining cane sugar. The largest refiner of cane sugar in the United States is also, through one of its subsidaries, one of the larger producers of beet sugar. No other company produces a significant quantity of both beet and refined cane sugar. The four largest producers provide about one-half of all the refined sugar used in this country. One of these companies produces beet sugar only; two only refine cane sugar, and the largest company produces both types.

None of the companies producing refined sugar ordinarily distributes its product throughout the nation, although the largest, with both beet and cane sugar, comes much closer than any of the other companies. Since refined sugar is a largely undifferentiated product and transporting it long distances is costly, producers are discouraged from attempting to obtain national distribution for their product. However, the market is not completely regionalized. Producers in different areas compete with each other over wide territories, particularly in areas where consumption greatly exceeds nearby production.

## PRICING REFINED SUGAR

Nearly all the refined sugar consumed in the United States is distributed by cane sugar refiners and beet sugar processors. This sugar is distributed primarily to industrial food processors, wholesalers and other large-scale users. Wholesalers redistribute sugar to retailers and other small-scale users.

The system of pricing refined at wholesale is frequently described as a multiple basing point system, in which the most important basing points are the cane sugar refining centers of New York, New Orleans, and San Francisco. The basing point feature is combined with a system of zones covering the country. Base prices, quoted by refiners and beet sugar producers, commonly vary among the zones, and zone boundaries shift from time to time. For convenience, we shall refer to this arrangement as a basing point system.

The delivered price of sugar at a destination which is not a basing point consists of the price at the basing point with the lowest cost to the point of delivery, plus freight from that point. The delivered price at any destination is the same regardless of the point of origin. Sellers of refined sugar pay the freight on the sugar from point of origin to point of destination but add to the quoted price a sum, called a prepay. This prepay is equal to the cost of moving sugar from the nearest basing point to the point of delivery. The prepay may be equal to, more than or less than, the freight paid by the seller.

For example, the prepay on sugar shipped from Colorado to Chicago ordinarily is less than the transportation cost, and the sellers' net return is less than the quoted price. However, for nearby destinations, such as Denver, the prepay would exceed transportation charges, and the seller would realize what is termed a freight gain rather than a freight loss. In other instances, usually deliveries in major port cities where cane sugar refineries are located, no freight gain or loss ordinarily accrues to the seller located in that city.

In practice, basing point prices frequently do not work out as neatly as has been described. Competitive conditions may cause one or another group of sellers to offer various concessions which result in delivered prices different, usually lower, than would otherwise be expected. Prices in Chicago are often cited as an example of this type of market. The probable cause is that the production of western beet sugar has increased substantially, and shipments to the Chicago area have risen even faster in an effort to find an outlet for the sugar without unduly affecting prices in the western part of the United States. Various price concessions, not available in most of the country, appear to have been an important factor in accomplishing this.

An estimate of the actual delivered wholesale prices of refined sugar at 109 cities in 1965 shows that the lowest average price for the year was 9.23 cents per pound at San Francisco, followed by New Orleans with 9.51 cents, Savannah with 9.65, and New York 10.30 (fig. 1). There was a tendency for prices to increase somewhat in proportion to distance from these points, although the pattern in the midwestern and great plains states is more complex due to the volume of beet sugar marketed there in competi-

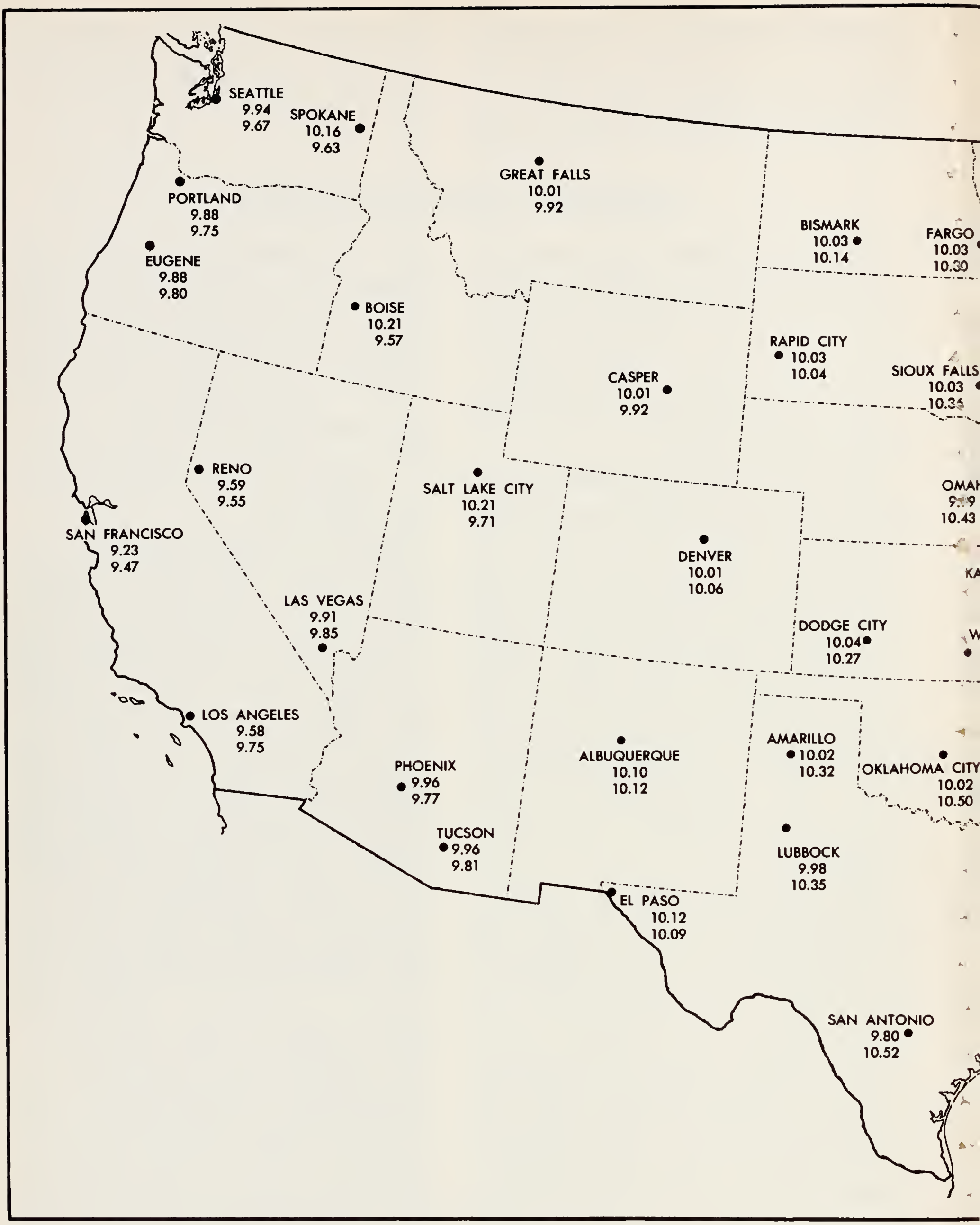
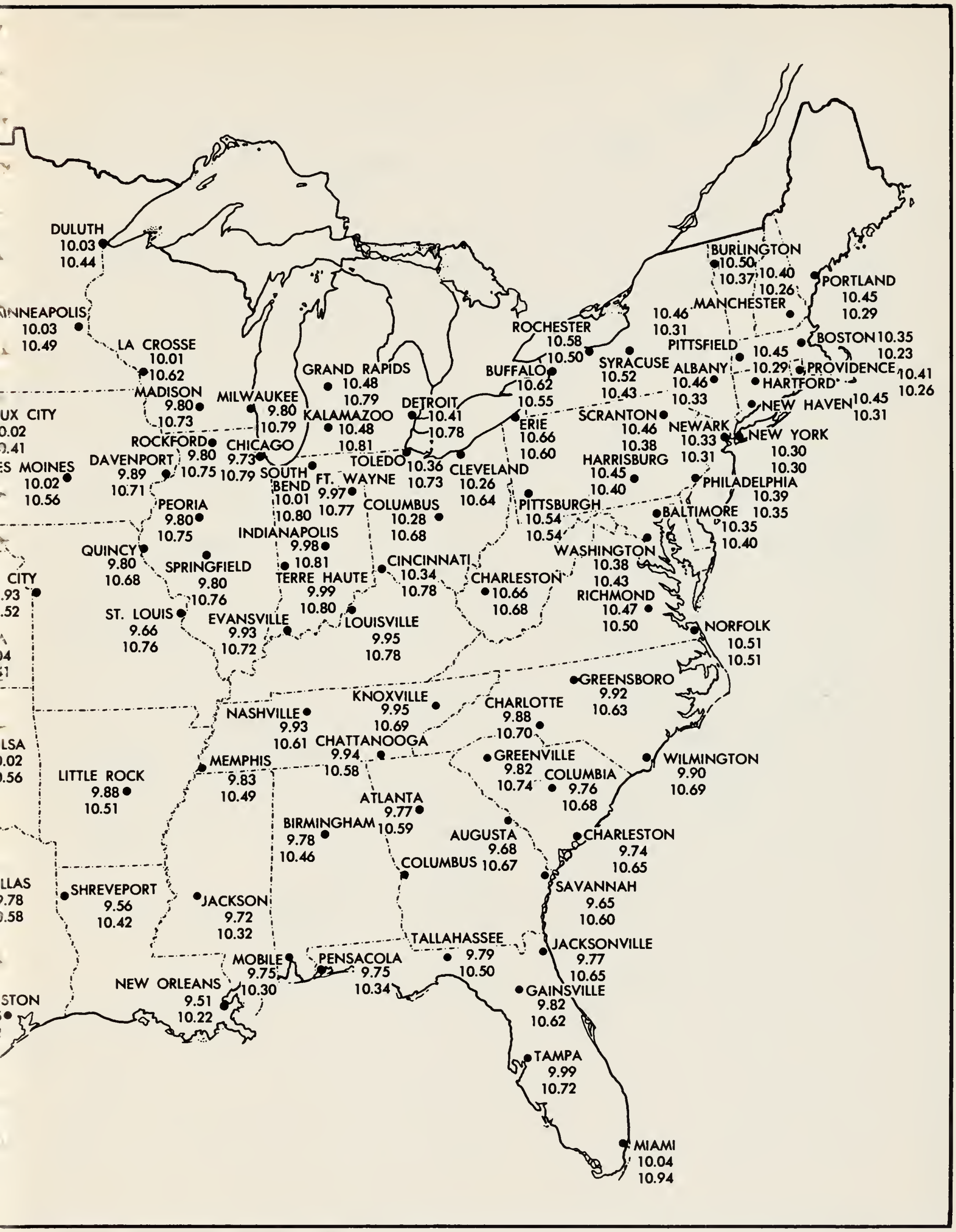


Fig. 1. Average actual aggregate delivered prices

tion with cane sugar coming from New York, New Orleans, and San Francisco. In general, this has resulted in lower prices in southern Wisconsin and most of Illinois and Indiana than in the Rocky Mountain and northeastern states.

The actual delivered prices are very different from the prices that would be



normative delivered prices of sugar, 1965.

expected to prevail if each seller charged all buyers the same price at point of origin for sugar at any given time, and the buyers paid all transportation charges. Under this system, different sellers would, of course, have different prices at the same time, since the volume of sugar to be marked by different sellers

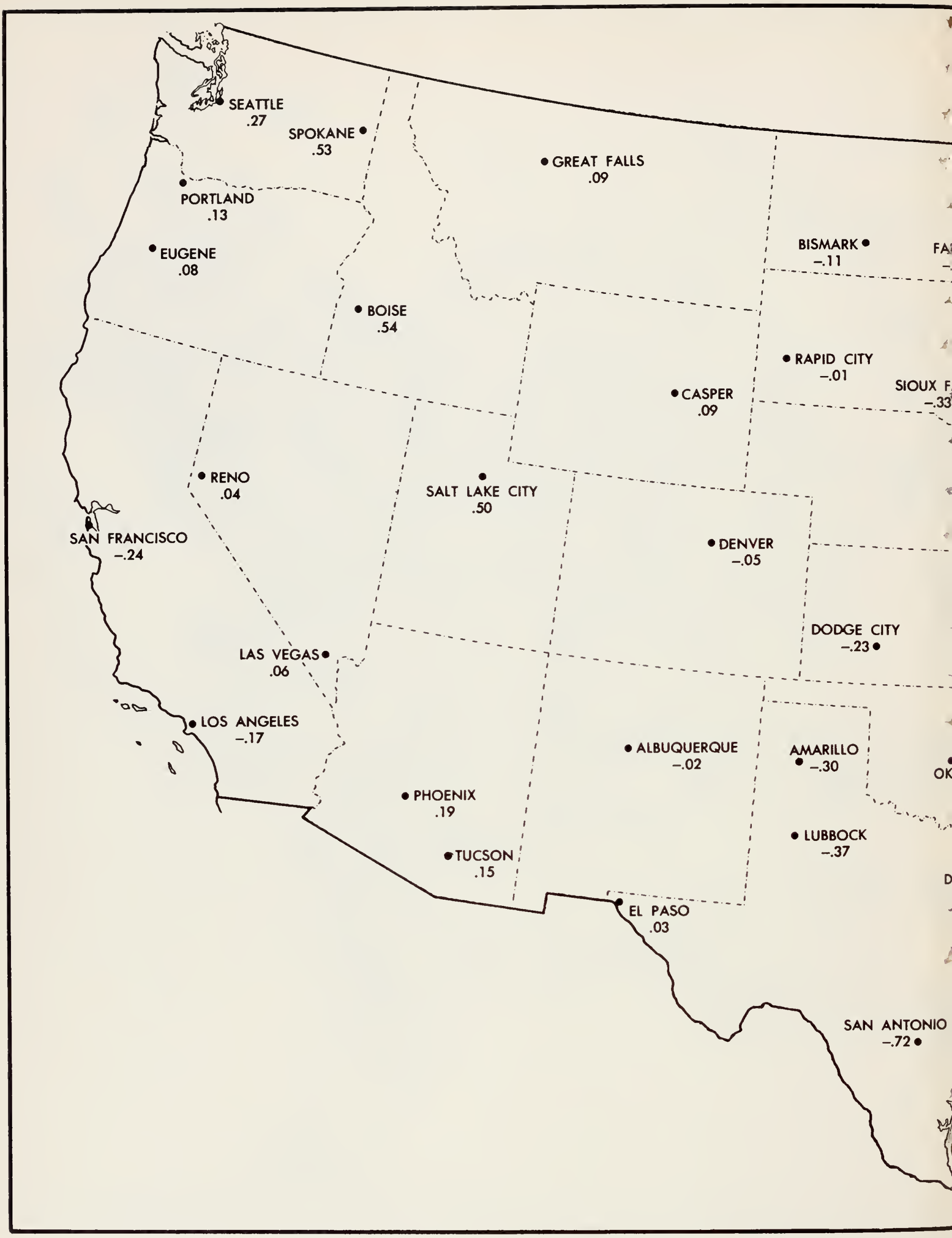
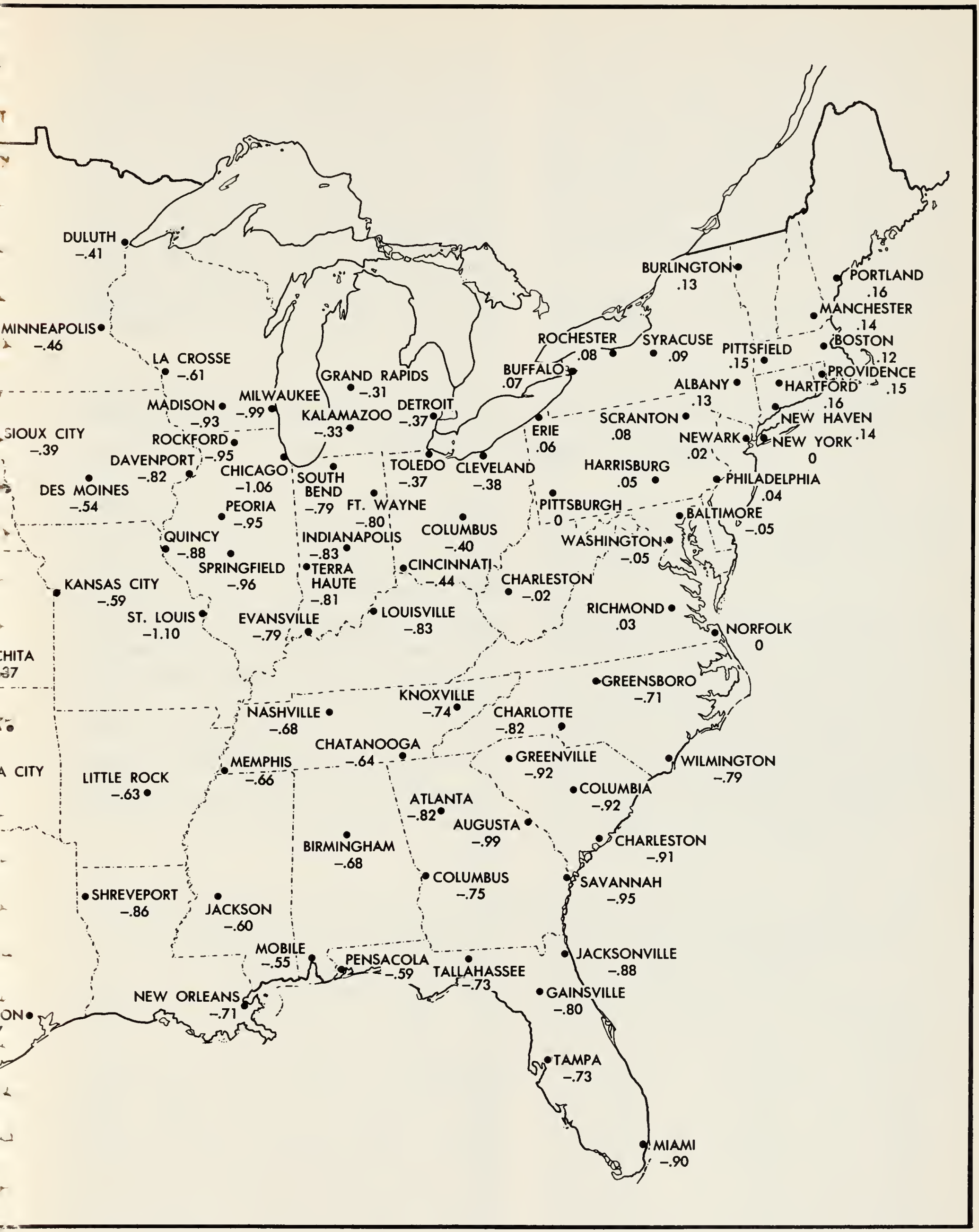


Fig. 2. Differential between ac

would be different, and the location and volume of competing supplies would vary. The system would operate so that sellers, as a group, would receive the maximum possible average price for their sugar; and buyers, as a group, would obtain their sugar at the lowest possible cost.

The resulting prices may be termed



nd normative sugar prices, 1965.

normative. They approximate the prices which would be expected to prevail if sugar were produced and sold by a very large number of persons, none of whom had sufficient volume to appreciably affect prices by withholding supplies from the market. Such normative delivered prices in 1965 for 109 points in the

United States have been calculated on the assumption that the normative and actual delivered prices at New York were the same (fig. 1). These normative prices, based on a price of 10.30 cents per pound for New York, would range from a low of 9.57 cents per pound for Boise, Idaho, to a high of 10.81 cents in Indianapolis, Indiana, and Kalamazoo, Michigan.

The differences between the actual and normative prices varied from a normative price 0.53 cent per pound below the actual price at Spokane, Washington, to 1.10 cents above at St. Louis (fig. 2). This means that sellers of sugar in Spokane actually received 0.53 cent per pound more than they would have received if normative prices had prevailed. Sellers in St. Louis received 1.10 cents less.

The map shows that sellers received more than the normative price at all delivery points, except Los Angeles and San Francisco, west of a line starting at El Paso, Texas, bending west of Albuquerque and running north through Casper, Wyoming. With the exception of points in New England, New York, New Jersey, and Pennsylvania, sellers received less than the normative price at all points east of the El Paso-Casper line. Actual and normative prices were assumed to be identical in New York City in order to provide a necessary basis for the calculation of normative prices at other delivery points. Any of the other points shown could have been used as the base point. New York was chosen because of its importance as an importing and refining center and its recognition in the sugar trade as a price-registering market for the entire country. Actual and normative prices were also identical at Pittsburgh, Pennsylvania, and Norfolk, Virginia. This was accidental.

The fact that actual delivered prices are above the normative prices in the northeast and in the western part of the country, except in California, and below them elsewhere is essentially a result of the existing system of pricing. The highest excess of actual over normative prices is in the mountain states in the cities of Spokane, Boise, and Salt Lake City. The amount by which actual prices exceed normative prices decreases east of these points, and the extent to which normative prices exceed actual increases from 0.05 cent in Denver to 1.10 cents in St. Louis and 1.06 in Chicago. East and south of these points they declined.

The data in figures 1 and 2 represent a single year. The figures would doubtless be different for other years. Such factors as the proportion of the country's sugar supply coming from the Pacific and Mountain states affect the behavior of prices over large sections of the country. Most of the variation in this supply is caused by fluctuations in the production of beet sugar in these states, although in certain years strikes which affected the output of Hawaiian sugar have been important in this respect. Changes in railway freight rates particularly for sugar coming East from the western states will also affect geographical price relationships.

The data presented are believed sufficient to describe in general terms the broad outlines of the results achieved under the existing pricing system for refined sugar and to compare them with what might be expected if the pricing pattern of the industry were of the type described as normative. This comparison does not prove, or even imply, that changes, which would result in prices closer to normative, are practical or would necessarily benefit the country as a whole. The economical production of cane and beet sugar requires the use of large plants, and the volume produced makes it necessary to distribute the product over a considerable geographic area. The number of these large plants needed is limited, and the output is large enough, so that most producers have enough market power to influence prices in certain areas.

Corn sirup also is commonly marketed through a multiple basing-point price system. However, no analysis of the effect of this system on the geographic pattern of prices paid by users, similar to that discussed for sugar, is available. The effects are likely to be similar in character to those for sugar. The geographic pattern of corn sirup prices may be considerably different, however, because most of the corn sirup produced in the United States is manufactured in the midwest where the basing points are located.

Delivered prices for noncaloric sweeteners in the United States have usually been uniform throughout the country, the sellers paying all transportation costs. Transportation costs for saccharin (and for cyclamate when it was in use) are relatively low compared to the value of the product, making this method of pricing feasible.

## ESTIMATED PRODUCTION POTENTIAL FOR SUGAR IN THE UNITED STATES

Steadily increasing sugar consumption in the United States, about 12 per cent from 1964 to 1969, raises questions concerning future sources of supplies and their prices—particularly when during that same period for consumers, U. S. sugar production made no appreciable increase.

There were significant variations in production trends among domestic producing areas in spite of approximately the same increases in the price of sugar for producers in each area. The 1965 amendment to the Sugar Act directed the Secretary of Agriculture, in determining the annual sugar consumption requirements of continental United States, to consider a number of factors, including the relationship between the price of raw sugar which the Secretary estimates would result from his determination, and the parity price index as compared with the average relationship between these items during 1957, 1958, and 1969.

**Table 7.**

**TREND OF SUGAR PRICES AND SELECTED PRICE INDEXES IN THE UNITED STATES EXPRESSED AS PER CENT OF 1957-TO-1959 (100 PER CENT) PRICE INDEXES (1957 TO 1970)**

| Year | Raw sugar* | | Parity index† | Prices received‡ |
|---|---|---|---|---|
| | *Cents per lb.* | *Per cent* | *Per cent* | *Per cent* |
| 1957 | 6.20 | 99.8 | 98.0 | 97.2 |
| 1958 | 6.23 | 100.4 | 100.3 | 103.4 |
| 1959 | 6.20 | 99.8 | 101.7 | 99.3 |
| 1960 | 6.26 | 100.8 | 102.4 | 98.9 |
| 1961 | 6.30 | 101.4 | 103.1 | 99.3 |
| 1962 | 6.45 | 103.9 | 104.8 | 101.0 |
| 1963 | 8.18 | 131.7 | 106.5 | 100.6 |
| 1964 | 6.90 | 111.1 | 106.8 | 98.1 |
| 1965 | 6.75 | 108.7 | 109.6 | 102.6 |
| 1966 | 6.99 | 112.6 | 114.0 | 110.1 |
| 1967 | 7.28 | 117.2 | 116.7 | 104.7 |
| 1968 | 7.52 | 121.1 | 121.2 | 108.0 |
| 1969 | 7.75 | 124.8 | 127.3 | 114.0 |
| 1970 | 8.07 | 130.0 | 133.1 | 115.8 |

* Duty paid, New York.
† Prices paid by farmers for commodities, interest, taxes, and wages.
‡ Prices received by farmers for all commodities.

The actual trends of raw sugar prices and the parity index have corresponded rather closely since 1957 (columns 2 and 3, table 7). In both series there was an increase of about one-fourth from 1957 through 1969. The rate of increase in prices paid by farmers during this period has been greater than the increase in index of prices received for all farm commodities, especially since 1966. Also the price of raw sugar has risen more rapidly than the average prices received for all farm products. These divergent trends have doubtless been a factor influencing the scale of operations of sugarcane and sugar beet growers and processors.

The wide divergence in recent production trends among sugarcane-producing areas can be understood only by considering the circumstances existing in each area. These circumstances may continue to influence output in future years.

## Florida (sugarcane)

Most of the very large increase in Florida sugar production occurred after the United States ceased importing sugar from Cuba in 1960. Florida sugar production in 1960 amounted to 158,000 tons raw value. Production peaked at 714,000 tons in 1967. Subsequent declines in 1968 and 1969 resulted from acreage restrictions imposed by the Department of Agriculture designed to keep production in the mainland sugarcane area in line with the quota established under the Sugar Act.

Aside from acreage restrictions due to the Sugar Act, the main restraint on Florida sugar production is the supply of suitable land where the climate is favorable for sugarcane. Except in areas south of Lake Okeechobee the danger of frost damage to sugarcane is an important deterrent to its commercial production. The moderating influence of the lake on temperature extends for only a few miles from the lake and limits cane acreage. Certain soil types in this area are poorly suited to the growth of sugarcane, further limiting sugarcane acreage.

Sugarcane production in Florida for 1971 was limited to about 206,000 acres, under Sugar Act Regulations. This is 7.6 per cent less than the peak acreage of 1964. In the absence of government acreage restrictions at current price relationships between sugar and other products, it is highly probable that sugarcane acreage in Florida would rise, at least to the peak figure of 222,900 acres. Since current milling capacity appears to be somewhat greater than that needed to process the cane from 222,900 acres, there would be an incentive for some mills to increase the acreage beyond this point.

A moderate 10 per cent reduction in the price of sugar, accompanied by the removal of acreage controls, probably would be followed by some increase in acreage above the 1971 level. The costs of producing a pound of sugar presumably would be reduced somewhat if the mills were able to operate closer to their optimum annual capacity.

A 10 per cent increase in the price of sugar probably would encourage sufficient expansion in acreage to cause some sugarcane processors to expand their milling capacity. Such expansion would almost certainly involve planting sugarcane on land with a greater frost hazard than that on most of the land now in sugarcane. However, the higher the price of sugar, the greater the frost risk that could be profitably incurred.

## Louisiana (sugarcane)

Sugar has been produced from sugarcane in southern Louisiana since 1795. Production in the state is almost wholly confined to alluvial soils deposited by the Mississippi River. Frost damage has always been a major production hazard which prevents the northward expansion of cane growing. At times diseases also have restricted output. The most serious of these was mosaic in the early 1920's. Primarily because of this disease, sugar production in Louisiana was reduced from 331,000 tons in 1921 to 48,000 in 1926. Production was increased with the introduction of new disease-resistant varieties, exceeding 300,000 tons again in 1936. Since 1960, production has ranged from 470,000 tons to peaks of 759,000 tons in 1963 and 740,000 tons in 1967. The decline to 537,000 tons in 1969 was primarily the result of acreage restrictions applied in line with the available sugar quota.

Potential increases in production in Louisiana, as in Florida, are limited by the extent of suitable soil within the area where climatic factors, primarily relative freedom from danger of frost damage are sufficiently favorable to permit profitable commercial production in most years. Most of the land in this area is swampy, requiring extensive drainage before sugarcane can be grown. Any sizeable expansion of sugarcane acreage will require substantial investment in additional drainage facilities.

Since World War II, the acreage of sugarcane in Louisiana has varied from a low of about 222,000 acres in 1956, when acreage was restricted by the government, to a high of 345,000 acres in 1964, when there were no acreage restrictions. In 1970, with restrictions reimposed, it amounted to 287,000 acres, 17 per cent below the peak. However, permitted acreage for 1971 has been raised to 330,100 acres. Average limitations imposed under the sugar quota law and the prospect of such limitations in future years, even when no limitation was in effect, appear to have had a considerable effect on actual sugarcane acreages cultivated in Louisiana. This makes it difficult to accurately estimate the acreages that might have been cultivated under freely competitive conditions and existing sugar prices over an extended period of years. The 1964 acreage appears to be the best available indication of such a situation in recent years, since the world shortage of sugar which developed in 1963 made future acreage restrictions appear somewhat distant.

Assuming the current price relationship between sugar and other products, the acreage in sugarcane would probably rise to at least the 1964 level, if no acreage restrictions were imposed by the government for several years. An increase in the current price of sugar would provide considerable stimulus to clear additional land for cane growing. The cost of land clearing and drainage has declined considerably since World War II because of the availability of better machinery. This has the effect of increasing the availability of land for cane growing at a smaller, although still substantial, investment per acre.

In the absence of acreage restrictions, a decrease in the price of sugar likely would have less effect in reducing cane acreage below the peak level of 344,900 acres than a higher price would in increasing acreage. Alternative crops commonly yield much less revenue per acre than sugarcane. If unused for several years the land becomes swamp again. Under these circumstances, land is likely to remain in sugarcane as long as it seems likely to yield sufficient revenue to pay the direct costs of planting, cultivating and harvesting cane. Also ratoons may be harvested an additional year or two beyond the customary period of two or three years.

The incentive to keep sugarcane growing on land at lower sugar prices will be greater in the central part of the growing area, where alternative crops are fewer and less remunerative than in the northern and western parts of the area. Also, some land along the Mississippi River may be removed from sugarcane growing, regardless of shifts in the price of sugar, because the land is desired for industrial uses.

## Puerto Rico (sugarcane)

Recent trends in sugar production in Puerto Rico have been opposite to those in Florida and Louisiana. A peak of 361,500 acres of sugarcane was harvested in 1957. This declined about 50 per cent to 180,000 acres in 1969 and 1970. The output of sugar dropped proportionately. Rising wage rates, which increased the cost of growing and harvesting sugarcane and a slower rate of mechanization of field work, particularly harvesting, than occurred in other domestic sugarcane growing areas, were the principal reasons for the decline.

The decline in production in Puerto Rico was much more severe in some regions than in others. Rolling or hilly topography, which makes the use of mechanical harvesters difficult or impossible, but on which cane could be grown with hand labor, has been a major factor greatly reducing sugarcane acreage in northern and eastern Puerto Rico. Reductions in the flatter lands of the south have been more moderate.

The Puerto Rican government and most of the remaining large producers on the island are making strenuous efforts to halt the decline in sugar output and, if possible, increase it somewhat. These efforts involve the development and introduction of new and better farm machinery, the introduction of higher yielding varieties of cane and the addition of cleaning equipment to the sugarcane mills, so that cane containing a relatively high percentage of trash can be processed efficiently.

One general effect of these improvements, if they succeed, will be to reduce the cost of producing sugar by lowering the number of man-hours of labor required to produce a ton of sugar. The average number of man-hours used to produce a ton of sugar from 1967 to 1969 was 88.17 in Puerto Rico. It was 23.97 in Louisiana, 17.48 in Florida, 10.72 in Hawaii, and 18.65 in the sugar beet area.

Assuming no change in sugar prices relative to those of other commodities, it seems likely that sugarcane acreage in Puerto Rico might stabilize at a figure slightly below the 1969 level. Some small areas of hilly land remain in sugarcane, mainly because some fields planted several years ago have not been plowed out and replanted at the usual time but are being left in cane as long as the yield is sufficient to pay harvesting costs. When yields become so low, usually after six or seven years, that it no longer pays to harvest the cane, the field is abandoned or converted to some other use.

If the recent sugarcane acreage is approximately maintained, the production of sugar in Puerto Rico is likely to increase somewhat because of efforts to increase yields of cane per acre and the sucrose content of the cane delivered to the processing mills. The possibility of improving yields of cane per acre arises partly from the gradual disappearance of cane from hilly land where yields were below average and the success of the efforts to obtain higher yielding varieties.

Cane growing is likely to cease on many of the small farms which frequently are not well suited to mechanization. In some areas small farms are likely to be combined in larger units, so that more effective use can be made of machinery. Management practices and yields may also improve as the land comes under control of better qualified operators.

Since World War II the sucrose content of sugarcane ground in Puerto Rico has declined from 12.2 per cent in 1950 to a low of 8.2 per cent in 1969. This decline appears to be the result of more trash, less timely harvesting, delays in milling harvested cane, concentration on varieties with lower sucrose content, and the like. More than half of this decline has occurred since 1962.

The cane ground in 1969 yielded 483,500 tons of sugar. If the yield had been as high as in 1962—10.44 per cent—the same quantity of cane would have yielded 615,665 tons of sugar, an increase of more than one-fourth. Prospects for reversing this downtrend in yield of sugar seem reasonably good.

With present price relationships between sugar and other products, a normal output of sugar per year might reasonably be estimated at around 600,000 tons. Any increase in the price of sugar would encourage further restoration of sugar production in Puerto Rico, since the remaining processing capacity is larger than needed for a crop of 600,000 tons. A decrease in the price of sugar relative to the prices of other products would seriously hinder the recovery of sugar production on any except the best lands, and output might not rise much above the level of 1970.

## Hawaii (sugarcane)

Sugar production in Hawaii since the end of World War II has been much more stable in volume than it has in the other domestic sugarcane areas. Output has fluctuated between 1,020,000 tons in 1952 and 1,234,000 tons in 1966. It was below 1 million tons in 1958, 1959, and 1960 when operations were adversely affected by a strike which reduced the size of the sugarcane crop not only in the year when the strike occurred but in the two following years. Sugar production first reached 1 million tons in Hawaii in 1931.

Only a limited acreage in the Hawaiian Islands is suitable for growing sugarcane. The maximum area reported growing cane in Hawaii was 254,600 acres in 1933. In 1969 it was 242,600 acres. The possibilities of developing new areas for sugarcane growing in Hawaii are very limited. Some areas, mostly on the Island of Oahu, formerly used for growing sugarcane have been converted to other uses, largely urban, military and recreational. A gradual increase in the average yield of sugar per acre has been sufficient in recent years to somewhat more than offset the slight decline in acreage.

It is likely that sugar production in Hawaii will remain relatively stable with current prices. Even a moderate rise in sugar prices probably would not have much effect on production, because of the limited land area available. Lower prices for sugar, however, might reduce output, particularly where alternate uses of land for livestock or other crops are feasible.

## Beet sugar

Sugar beets were grown in 24 states in 1969. However, the combined area planted in six states—Arkansas, Iowa, Missouri, New Mexico, New Jersey and Pennsylvania—amounted to less than 0.3 per cent of total United States acreage. At the opposite end of the scale, California accounted for 18 per cent of the total. Less than 10 per cent of the 1969 planted beet acreage was in states east of the Mississippi River.

Trends in the acreage planted to sugar beets since the late 1950's have varied widely among the states where they are grown. For convenience, these states may be divided into three groups (table 8). The expansionist group of states where acreage has increased most rapidly are Washington, Oregon, Idaho, North Dakota, Minnesota, Kansas, Texas and Arizona. In the three years (1957 through 1959) an average of about 28 per cent of United States sugar beet acreage was in these states. In 1969, the year of peak acreage for both the expansionist states and the United States, they provided 42 per cent of total beet acreage. California had 22 per cent of the beet acreage from 1957 to 1959. This increased to 25 per cent in 1964, when the acreage in California reached a peak. In 1969, the year of peak acreage for the United States, California accounted for only 19 per cent of the total. The "other" group of states had 50 per cent of total beet acreage from 1957 to 1959 but only 39 per cent in 1969.

United States sugar beet acreage declined about 10 per cent in 1970 from the 1969 peak. Acreage in California in-

Table 8.

### COMPARATIVE GROWTH IN THE PLANTED ACREAGE OF SUGAR BEETS BY AREAS IN THE UNITED STATES (1957 TO 1970)

| Year | Expansionist area* | California | Other states | Total |
|---|---|---|---|---|
| | *1,000 acres* | | | |
| 1957 | 259.0 | 207.1 | 454.9 | 921.0 |
| 1958 | 256.3 | 214.0 | 471.5 | 941.8 |
| 1959 | 260.9 | 205.7 | 475.0 | 941.6 |
| 1960 | 280.9 | 214.9 | 483.6 | 979.4 |
| 1961 | 347.7 | 258.1 | 539.9 | 1,145.7 |
| 1962 | 379.1 | 252.0 | 547.9 | 1,179.0 |
| 1963 | 401.1 | 320.0 | 578.4 | 1,299.5 |
| 1964 | 494.5 | 361.7 | 599.7 | 1,455.9 |
| 1965 | 476.3 | 312.7 | 519.3 | 1,308.3 |
| 1966 | 460.9 | 288.4 | 493.6 | 1,242.9 |
| 1967 | 509.6 | 235.0 | 480.7 | 1,225.3 |
| 1968 | 632.6 | 263.7 | 579.9 | 1,476.2 |
| 1969 | 690.7 | 320.0 | 636.4 | 1,647.1 |
| 1970 | 607.4 | 328.0 | 539.8 | 1,475.2 |

* Washington, Oregon, Idaho, North Dakota, Minnesota, Kansas, Texas, and Arizona.

creased slightly, but it declined in both other areas as a result of difficulties with harvesting and processing the 1969 crop and of lower yields of sugar.

The greatest increase in acreage since the 1957-to-1959 period in the expansionist states has occurred in the Columbia River basin in Washington and in the Red River Valley of North Dakota and Minnesota. Successful production of sugar beets began somewhat later in these areas than in many other states. New sugar beet processing plants have recently been built in Kansas, Texas, and Arizona, further stimulating beet acreage increases in the expansionist states.

In recent years a few small mills have ceased operation in California, Kansas, Nebraska, Colorado, Utah, Montana and Minnesota. Production figures for these mills are not available, but it is apparent that the volume of beet sugar produced in the United States has not been materially affected by these closings. In several cases part of the beets formerly processed at these plants has been diverted to some other mill which has continued to operate. Also, the capacity of many of the remaining mills has been gradually increased. The mill which closed in Minnesota is not in the Red River Valley, but in an area of the state where beet acreage is less concentrated. Two mills built in the 1960's, one in New York and one in Maine, have not succeeded in obtaining sufficient acreages of beets to operate successfully.

An important factor affecting changes in sugar beet acreage in all areas is the change in the price growers receive for their beets. These prices are related by contract to prices received for sugar by the processors who purchase the beets. The trend in sugar beet prices, since 1957-to-1959, has been upward but at a slower rate than the rise of raw sugar prices at New York. Average beet prices for all growers in the United States from 1967 to 1969 were 13.4 per cent above their 1957-to-1959 level, while the rise for raw sugar was 21.0 per cent. A major reason for the difference was that the costs of marketing beet sugar increased, because increasing supplies had to be shipped longer distances, with an accompanying increase in cost, in order to find a market.

The primary factor determining the acreage planted to sugar beets each year is the growers' estimate of the relative profitability of beets and other crops. In certain years and some states, acreage has also been restrained by limitations imposed by the government under provisions of the Sugar Act or by the inability of the mills in certain areas to process as many beets as growers would have liked to produce. However, the effects of government and processing limitations usually have been confined to a few years and areas. Since sugar beets are an annual crop grown in rotation with other crops, competition among these crops for the use of the land is always present, and shifts involving beet acreage are comparatively easy to make. As a result, pronounced fluctuations in beet acreage are much more likely than is true for sugarcane, where several successive crops are harvested from a single planting.

One of the factors causing the decline in sugar beet acreage in California from 1964 through 1967 appears to have been the increasing profitability of growing tomatoes for processing in parts of the beet growing area. During this period the value per acre of tomatoes increased about 17 per cent as compared with 5.5 per cent for sugar beets. On the other hand, there appears to have been a greater profit in producing sugar beets than competing crops in the Red River Valley and Columbia River basin in most years since the end of World War II.

An increase in the price of sugar and beets relative to other crops is certain to create a desire by many growers to expand their beet acreage. The actual effect on acreage in most areas is likely to be restrained to some extent by the capacity of available processing plants. Processing capacity can be increased either by enlarging existing plants or building new ones. In either case, the process is likely to lag behind growers' desires for more acreage because of the capital costs and time needed for construction. Also, a sugar mill has no alternate uses in case the needed supply of beets does not materialize. Farmers have better alternatives, if their beet operations prove less profitable than anticipated.

Detailed analyses of beet-acreage response to changes in the price of beets relative to competing crops are not available. However, available information indicates that the response would be considerable in the expansionist states, particularly in Minnesota and North Dakota. Prospects for expanding beet acreage in states where no beets or only a few are grown do not appear favorable. At least, recent attempts to establish the industry in New York and Maine have not been noticeably successful. Competing crops appear to offer more favorable opportunities to most farmers. The situation in California is more complex because of shifts in the competitive advantage of beets and other crops. A decline in the price of beets relative to competing crops might well reduce acreage in many states, especially if the decline lasted several years. The price formula in the Sugar Act, which is a guide for determining consumption requirements, has encouraged relatively favorable prices in recent years for sugar and beets—because the formula has been based on the index of prices paid by farmers, which has increased more rapidly than the index of prices received.

## SUGAR POLICY

The production, importation, and marketing of sugar in the United States, and in most other large consuming and importing countries, is closely regulated by the United States government in such a manner as to strongly influence domestic sugar prices. In the United States, prices have usually been well above prices in the world sugar market. Only in some unusual situation, such as the world shortage of sugar in 1963 and 1964, have prices in the world market been above those in the United States.

Also, United States sugar prices have been unusually stable. This stability has resulted from the manner in which the Sugar Quota Law has been administered. Prices have been maintained at a relatively high stable level by increasing and decreasing annual sugar marketing quotas needed to prevent all but minor price fluctuations. These characteristics have undoubtedly been of great economic benefit to producers of beet and cane sugar in domestic areas.

Generally higher prices in the United States have been reflected in higher prices paid for sugar by consumers. While some consumers have benefited from the stability of prices, partly offsetting the burden of high prices, other consumers have been placed at some disadvantage by being unable to take advantage of lower seasonal and temporary prices that might have been available with a less regulated market.

The effects of the United States sugar program extend beyond its benefits to the domestic sugar industry and the payment of higher prices by consumers. For one, producers of corn sweeteners indirectly benefit from high prices for sugar. Such prices for sugar reduce its effectiveness in competing with corn sirup and dextrose. Another effect is that the volume of United States sugar imports, of course, is smaller than would be expected, if the domestic industry was not protected. The higher price received by exporters for shipments to the United States offsets to some extent the disadvantage of their lower sales volume.

The net effect on the industry of the exporting country varies widely among these countries. For instance, practically all the sugar exported from the Philippines comes to the United States, and producers in the Philippines sometimes have been unable to send as much sugar to the United States as would have been permitted by this country's quota regulations. Under these circumstances it is clear that sugar producers in the Philippines have benefited substantially from the operation of the United States sugar quota system.

However, other countries whose sugar exports to the United States constitute only a small part of their total exports also ship considerable quantities to the world market, frequently for very low prices, and they would doubtless benefit from free trade in sugar or even a lower level of protection by this country. Brazil, Australia and Taiwan are excellent examples of countries in this position, as was Cuba prior to 1960.

The divergent interests of consumer and producer groups in the United States and of foreign producers provide much of the background against which government sugar policies are formed in this and other countries. For sugar importing countries, such as the United States, the most important question concerns the degree of protection to be given the domestic sugar industry. This is the prime factor determining the quantity of sugar produced by the domestic industry, also the quantity imported as raw or refined sugar. It also influences sugar price levels in this country compared to those in the world market. It is noteworthy that, since 1934, policy discussions have centered largely on the degree of protection desirable for the domestic sugar industry, there being general agreement that some protection was desirable.

The United States government by repeatedly extending the life of the Sugar Quota Law has consistently approved this form of legislation and, in effect, determined that this country would benefit from the presence of an active, prosperous sugar industry within its borders. This gives substantial protection to consumers here from the uncertainties of foreign supplies.

A result of protecting the domestic sugar industry in the United States and other sugar-importing countries is to increase the resources (land, labor, and capital) used in such countries for the production of sugar and thereby reduce the amounts available for other enterprises, which might operate profitably without the help of protective devices such as those provided for the sugar industry. The opposite happens in the sugar exporting countries, except where exports are subsidized. Some of the resources there, which might otherwise be profitably used to produce sugar for export, are necessarily employed in other enterprises or remain idle.

As a result of sugar trade restrictions, the volume of world trade in sugar and other commodities is reduced. However, countries which find their sugar exports limited by import quotas or other devices imposed by importing countries frequently have been able to become more self-sufficient in certain products which they would otherwise import. This affords a measure of protection against unexpected declines in their sugar exports.

The overall result is that some of the advantages of product specialization among countries theoretically made possible by international trade are lost through government trade restrictions.

## SUMMARY

The principal sweeteners in commercial use in the United States are cane and beet sugar, corn or starch sweeteners (corn sirup and dextrose), and saccharin, a nonnutritive sweetener. While sugar is by far the most important sweetener, the consumption of corn sirup has been increasing much more rapidly in recent years than that of sugar. Relatively lower prices for corn sirup have been an important factor producing this result, although some corn sirup is used in products where it replaces little if any sugar.

The United States is a large producer of both cane and beet sugar; it is also the world's largest sugar importer. Both domestic production and imports have increased since the end of World War II. Since 1960, when the United States ceased purchasing sugar from Cuba, imports have come from about 30 countries—the largest quantities coming from the Philippines, Dominican Republic, Mexico, Brazil and Peru.

Since 1934, the domestic sugar industry in the United States has been protected by a quota system under which both the production and marketing of sugar from domestic areas and imports are regulated. This has been done in such a way that sugar prices in the United States have usually been higher than those in the world market.

Structurally, the cane sugar industry is divided into sugarcane growing, the manufacture of raw sugar from cane and the conversion of raw into refined sugar. There is a considerable degree of vertical integration in companies performing these functions. Many companies owning one or more raw sugar mills also grow all or a part of the cane they process. In some cases, they also operate refineries where the raw sugar they produce, plus raw sugar purchased from others, is converted to refined sugar. However, some refiners, including the largest one, purchase all the raw sugar they process. Since nearly all sugar imports are in raw form, the quantity of sugar handled by refiners is considerably greater than that of mills producing raw sugar.

Beet sugar is produced in refined form by the mills which process the beets. Sugar beet processors buy the beets they process; they do not produce their own beets.

Refined sugar in the United States is sold under a system of multiple basing points, which produces a geographical pattern of prices different from what would be expected if each seller charged all buyers the same prices at point of origin. Under this system, beet sugar producers in Western states commonly sell sugar in Chicago at a lower net return than they receive for sugar sold in nearby areas such as Denver.

Potential increases in sugar production in the United States, with a moderate increase in prices, vary considerably among areas. They appear to be lowest in Hawaii and relatively large in Florida. Some recovery of production in Puerto Rico from its recent low level appears probable in the early 1970's. The potential for increased output of beet sugar seems largely confined to certain areas where conditions are unusually favorable. The most promising one is the Red River Valley area in North Dakota and Minnesota.

The most important policy question concerning sugar in the United States is the determination of the degree of protection to be provided to the domestic sugar industry. The focal point in such a determination is the price producers receive for their sugarcane and beets. This is indirectly determined by the Sugar Quota Law and the manner in which it is administered.

The maintenance of higher sugar prices in the United States than in the world market, except occasionally when world sugar production and trade have been seriously disrupted, has been of great benefit to domestic growers. However, it has meant relatively high prices to United States consumers and has encouraged the use of increasing quantities of substitute sweeteners.

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## ABSTRACT

At existing or moderately higher prices sugar production in domestic areas probably would increase somewhat over 1970 levels. Production in Puerto Rico likely will recover partially from its recent low but not enough to approximate the output of the early 1960's. Growth possibilities in the mainland sugarcane area are considerably larger than in Hawaii or Puerto Rico. Increases in beet sugar production are likely to be confined to a few favored areas, such as the Red River Valley. Competition for sugar from other sweeteners, particularly those manufactured from starch, is likely to increase. Relatively high sugar prices encourage the use of sugar substitutes. This in turn raises questions about current United States sugar policies and the degree of protection that should be given the domestic sugar industry.

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